Bill 73 (2017)
Early Testimony

Oahu Litter Index

Conducted by
Keep the Hawaiian Islands Beautiful and Kupu

Final Report

September 2017

Report Prepared by Environmental Resources Planning, LLC

for Keep the Hawaiian Islands Beautiful

Keep the Hawaiian
Islands Beautiful

KEEP AMERICA BEAUTIFUL AFFILIATE

ER PLANNING

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Acknowledgments

The Litter Index project required an extensive amount of planning time throughout 2016 in preparation for the actual survey that was conducted in January 2017. Thanks to all the project partners who contributed to the planning and execution of the Litter Index:

Keep America Beautiful
- Provided support in hiring Kupu Fellow Blaire Langston and provided Litter Index training to Kupu, ACC, and Keep the Hawaiian Islands Beautiful.

Keep the Hawaiian Islands Beautiful
- Provided administrative support and guidance for volunteer outreach, project logistics, summarizing of results in ArcGIS, and preparation of the project report.

Kupu's RISE Program
- Kupu RISE Fellow, Blaire Langston, led project management and overall execution.
- Kupu RISE program provided professional development, outreach materials and strategizing, access to a company car for initial site visits, administrative duties, advisement, work and meeting space, and additional resources as needed.

808 Cleanups
- Provided volunteers for helping to conduct the Litter Index.

Environmental Resources Planning, LLC
- Handled the site selection process, GIS mapping and detailed site data, data analysis and preparation of the project report.

American Chemistry Council and its Plastics Foodservice Packaging Group
- Provided financial support and professional guidance.

Keep the Hawaiian Islands Beautiful (KHIB) on behalf of Keep Honolulu Beautiful coordinated the first Oahu-wide Keep America Beautiful (KAB) Community Appearance Index - Litter Index, a research tool of KAB. This was conducted with assistance of Nani' O Waianae, a local affiliate of Keep America Beautiful who has conducted the Index in their area. The Litter Index visually assesses community appearance, specifically the current state of litter. It provides a baseline for ongoing annual comparisons of litter conditions and assists affiliates in identifying trends and determining behavior strategies to implement to address specific littering problems.

Planning and Resources

With assistance and funding by the American Chemistry Council (ACC) and its Plastics Foodservice Packaging Group, a local Litter Index was planned for Oahu with technical assistance from consultant Environmental Resources Planning, LLC (ERP). ERP used statistical and GIS software to select and map sites representative of land use types (e.g. residential, commercial, industrial, etc.) and roadway types (e.g. arterials, collectors, freeways, etc.) throughout Oahu. A comprehensive package was developed by ERP with detailed maps, information and photographs of each sample site, which were reviewed by KHIB.

Blaire Langston, a fellow with KHIB through the Kupu RISE Program, managed the implementation of this project with training from KAB and KHIB. Ms. Langston is a graduate student at University of Hawaii at Manoa pursuing a Master of Science in natural resources and environmental management, and has a background in the field of land-based contributions to marine debris, the focus of her current studies. Blaire coordinated recruitment and training of a field team to conduct island-wide Litter Index of 90 sites, 10 within each area, corresponding to the nine Honolulu City Council districts.

Results

The Litter Index quantifies litter on a four-point Likert Scale (with 1 being the least littered and 4 being extremely littered.) Results show that Oahu, based on sites selected, is generally clean with an overall score of 1.8 or slightly littered. The majority of sites surveyed had low levels of litter - 72 of the 90 sites had a score of 2.0 or lower. Only eight of the 90 sites had a score of 3.0 or higher and only one site yielded a score of 4.0.

Site scores were similar when considering the land use type or roadway type. The average Area/District scores were also similar to one another as shown below in Figure ES1. This suggests that focusing on the hot spots identified by this survey would be an effective approach to begin addressing litter and illegal dumping in Oahu. Doing so will help maintain Oahu's natural beauty and decrease the impact of litter on the environment and communities.
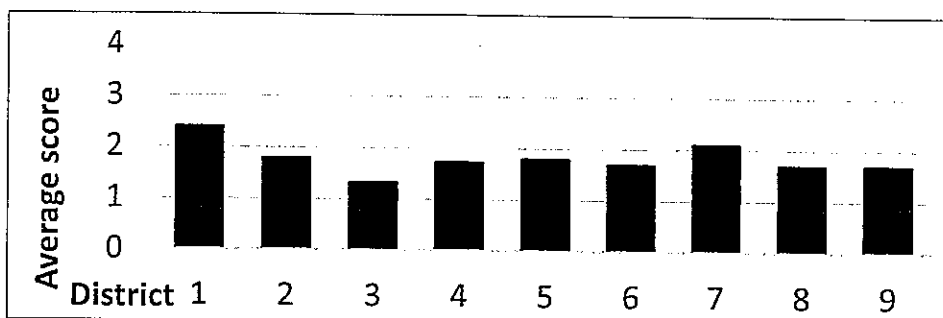
Figure ES1 - Average Litter Index Score by District

Littering Sources and Causes

Analyzing the quantity and composition of litter typically suggests its source as well as which approaches are likely to have the most significant impact on litter reduction. Sources of litter include motorists, pedestrians, improper residential set-out, improper commercial dumpster usage, or construction activity. Litter may be identified as either intentional (items that are knowingly dropped or thrown) or unintentional (items that fall, blow, or are otherwise misplaced through negligence such as failing to properly secure loads, improper maintenance of trash receptacles, etc.).

Understanding the relative contributions of intentional and unintentional activity can help to identify potential solutions. Some areas may have a mix of both, for example litter generated along roadways may be intentional littering by a person throwing an item from a vehicle or may be unintentional trash blown from uncovered truck loads and unlidded trash receptacles.

Litter in Coastal Communities

Littered items of all types can easily make their way into stormwater systems and waterways. This is a particular risk for coastal communities where pathways to waterways are very direct. Litter makes its way to local beaches, creating a visible eyesore for local tourism as well as a potential impact to wildlife.

This litter can have significant adverse financial impacts as well. Once littered items make their way into harbors and waterways, these littered items constitute illicit discharges and have already resulted in high legal costs and significant penalties for Honolulu entities. Violation of federal clean water statutes resulted in a $1.2 million fine issued to Hawaii Department of Transportation in 2014 for stormwater trash found at Honolulu and Kalaeloa harbors[1].

Litter abatement efforts should have clear financial and aesthetic benefits for the City and County of Honolulu and the State of Hawaii.

Community Appearance Index - Litter Index

The Litter Index is a qualitative index using a Likert scale to measure changes in a community's appearance over time. This measurement tool captures the current state of litter in a community and can help determine the effectiveness of local litter abatement efforts over time. KAB affiliates are required to use this tool for their program to become certified and to remain in good standing.

In an effort to determine the overall litter conditions on Oahu, KHIB submitted a proposal to American Chemistry Council to fund the Oahu Litter Index with four specific goals: (1) visually assess community appearance, (2) provide a baseline for annual comparison, (3) identify trends and (4) provide the basis for setting improvement goals.

The Litter Index also includes optional indicators that can be used to evaluate other aspects of a community's appearance: abandoned and junk vehicles, graffiti, illegal signs and outside storage. Those indicators were not evaluated in this initial survey, but could be assessed in subsequent surveys.

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[1] http://khon2.com/2014/09/10/dot-to-pay-1-2-million-for-stormwater-violations-at-honolulu-kalaeloa-harbors/

Site Selection

The first step in implementing a Litter Index is to divide a defined affiliate geographic boundary into areas based on political districts, school districts or other similar boundaries. For Oahu, City Council districts were chosen, segmenting the island into nine areas with similar populations.

Within each of the nine City Council districts, 10 sites representative of land use types (e.g. residential, commercial, industrial, etc.) and roadway types (e.g. arterials, collectors, freeways, etc.) were selected by ERP using statistical and DIVA-GIS software. Based on KAB criteria, all sites were 0.5 - 1.0 miles in length. Specific sites were selected so that land uses and roadway types were represented appropriately with each site representing just one roadway type. Additionally, each site represents primarily one land use type whenever possible. The majority of sites are intended for a windshield survey (conducted while riding in a moving vehicle) with several walking sites also allocated.

A comprehensive sites package was provided to the survey team that included detailed maps with GIS coordinates, starting and ending streets, site photos and a live link to an online map of each site in addition to a summary listing of sites by district.

Volunteer Selection

Volunteer outreach was done through collaborative efforts of KHIB and Kupu. KHIB reached out to over 60 stakeholders via e-mail including neighborhood boards, environmental non-profits and community groups. KHIB participated in several neighborhood board meetings to announce the event, recruit volunteers and notify the community of organization of the event. Flyers were created and distributed throughout Oahu and at the University of Hawaii - Manoa campus. Additional outreach via e-mail to students, current Kupu interns, fellows and alumni were sent. A Facebook event for the Litter Index was created to facilitate recruitment and create awareness.

Training

Two official KAB training sessions were held at the Kupu office building located at 677 Ala Moana Boulevard in Honolulu on January 3rd and 4th. Each training consisted of 5-6 volunteers and lasted about 60 minutes. Training included a 20-minute PowerPoint presentation explaining the Likert scale and surveying protocol in detail. Volunteers were provided with handouts and survey sheets. KAB provided a five-minute video illustrating the methodology with images and explanations. Feedback regarding the trainings was positive. Volunteers noted that the information provided, especially the video, pictures and examples, helped them conduct the Litter Index effectively.

Survey

The Litter Index was conducted by volunteers from KHIB and community members over a period of three days (January 3-5, 2017). Each day was planned so that Litter Index could be conducted during daylight hours between 8:00am and 5:30pm. This schedule allowed additional time to account for traffic, logistical issues and unexpected challenges.

Teams of four scorers visually rated each site without communicating with one another, ensuring a more objective score. The team leader then collected score sheets and averaged the team scores for each site. The resulting data is summarized in this report.

The implementation of this project was managed by Blaire Langston, a KHIB Fellow through the Kupu RISE program.

Site Ratings
Sites were rated based on a four-point Likert scale used by KAB as detailed below:

1. Minimal or No Litter
Litter: Virtually none (1-2 items at most)
Clean Up: Could be collected quickly
by one person
Notes: Entire area appears neat and tidy

Figure 1 - Minimal or No Litter

2. Slightly Littered
Litter: Small amounts visible
Clean Up: Could be collected fairly quickly
by 1 person
Notes: Area not continually littered

Figure 2 - Slightly Littered

Figure 3 - Littered

3. Littered
Litter: Readily seen throughout the area
Clean Up: Could be collected by 2-3 people over several hours
Notes: Organized cleanup effort required
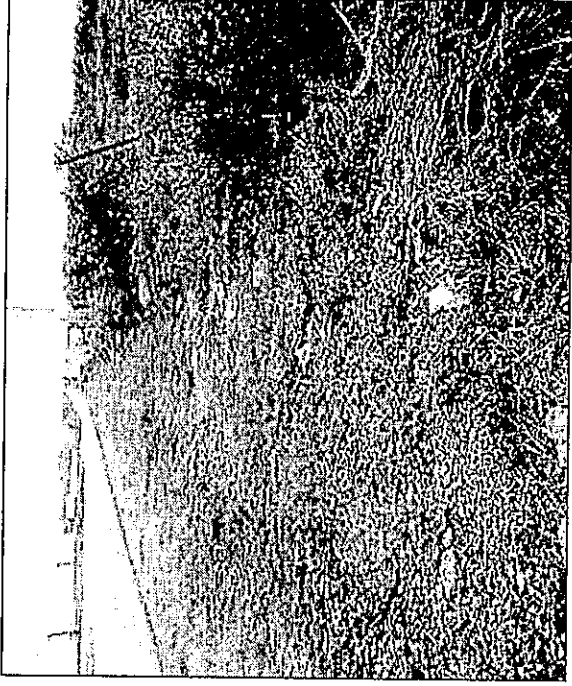
Figure 4 - Extremely Littered

4. Extremely Littered
Litter: Continuous throughout the site
Clean Up: Requires equipment and 3-4 people
Notes: Possibly an illegal dump site

Overall Score

The overall average score of 1.8 for Oahu reflects an island community that is generally clean, with isolated hot spots that would benefit from a focused litter abatement program.

Scores by District

As shown in Figure 5, the scores by district were similar overall, suggesting a fair level of continuity throughout the island.
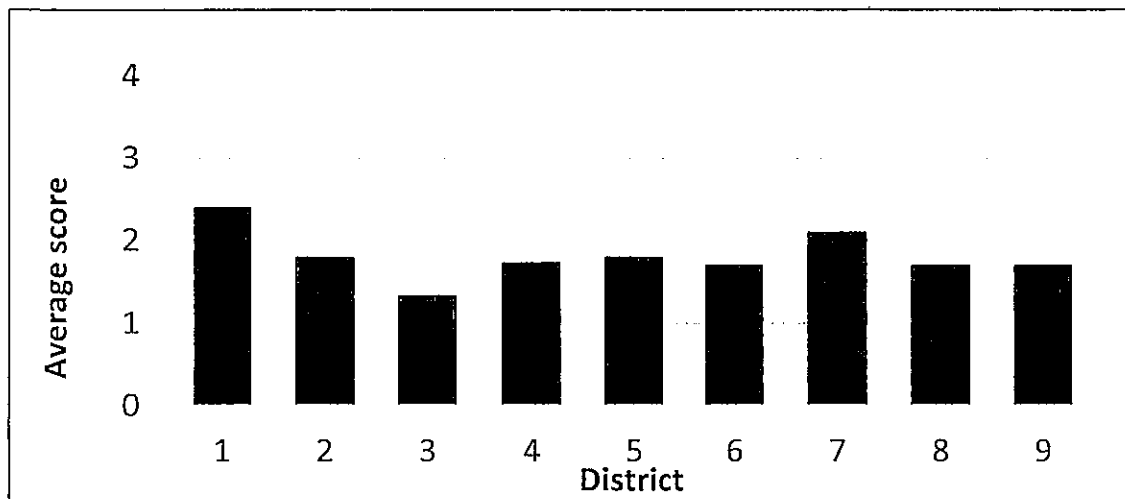
Figure 5 - Average Litter Index Score by District

District 1 yielded the highest average score (2.4), while District 3 yielded the lowest average score (1.3) as shown in Table 1 on the following page. These two districts showed the widest variation in Litter Index scores. District 1 is a more industrial section of Oahu, while District 3 is primarily residential. Litter rates tend to be higher in industrial areas due, in part, to the level of traffic and types of vehicles that typically travel through those areas.

Table 1 - Litter Index Scores by District

District	Avg. Score
1	2.4
2	1.8
3	1.3
4	1.7
5	1.8
6	1.7
7	2.1
8	1.7
9	1.7
All	**1.8**

Scores by Land Use Type

As shown in Table 2, scores by land use type show a similar correlation, with industrial areas tending to be the most littered and residential areas the least littered.

Table 2 - Litter Index Scores by Land Use Type

Land Use Types	#	Score
Residential	24	1.5
Commercial	27	1.7
Recreational	19	1.9
Rural	9	1.9
Industrial	11	2.3

Scores by Roadway Type

Comparing scores by roadway type, as shown in Table 3, shows that expressways and on/off ramps were the most littered, while arterials were the least littered. Roadway type generally correlates with traffic density levels, meaning the most heavily used roadway types tend to have the highest rates of litter.

Table 3 - Litter Index Scores by Road Type

Road Types	#	Score
Arterial	27	1.6
Collector	29	1.7
Park	12	1.9
Freeway	13	2.0
Expressway	4	2.2
Ramp	5	2.2

Scores by Walking or Driving

Thirteen walking sites were included in this Litter Index. Walking surveys allow more direct observations and insights than are possible while in a vehicle. The average scores for walking sites (1.76) and driving sites (1.82) round to the same score as shown in Table 4, suggesting consistency regarding visible litter between site types.

Table 4 - Litter Index Scores by Walking and Driving

Walking/Driving	#	Score
Walking	13	1.8
Driving	77	1.8

Distribution of 3.0+ Scores

Results show that a majority of sites throughout the island have low litter rates, with 72 of the 90 sites having a score of 2.0 or lower. The most littered areas are highly concentrated, with the dirtiest eight sites located in four districts as shown in Table 5. Only one of the 90 sites yielded a 4.0 score.

Table 5 - Litter Index Scores 3.0 and Higher

District	Site	Score
1	3	3.00
1	5	3.00
1	7	3.00
2	10	3.67
6	9	3.00
6	8	3.25
7	1	3.00
7	6	4.00

This suggests that focusing on a limited number of hot spots is the most effective approach to address litter and illegal dumping in Oahu. Reducing litter in these hot spots will help lead to an improved Litter Index score in future surveys.

District 1

Table 6 - District 1 Site Locations and Scores

#	Area/Street to Survey	Starting Point	End Point	Score
	District 1 Sites			
1	Kalaeola Blvd.	2009 Lauwiliwili Street	Malakohe St.	1.0
2	Olai St.	Barber's Point Beach Park Cul-de-sac	End of Canal	2.7
3	Kaomi Loop	91-120 Hanua St. at Kuhela St.	Island Recycling	3.0
4	Farrington Hwy. 93	86-50 Glenmonger St.	Kauilokalani St.	2.7
5	I-H-1	Exit 1A Ramp	Kapolei Pkwy.	3.0
6	Farrington Hwy. 93	Kaena Point: asphalt road ends	Dirt road loops to main road	1.3
7	I-H-1	488 Kamokila Blvd.	Past Walmart	3.0
8	Waianae Boat Harbor Prk Lot	85-371 Farrington Hwy. (Ice House)	Loop back to Ice House	2.7
9	Malakole Street	91-303 Kaiholo Street	Marisco Ltd.	2.7
10	Paaki Street	92-681 Paakai Street	Laaloa St.	2.0

Figure 6 - District 1 Sites Map

District 2

Table 7 - District 2 Site Locations and Scores

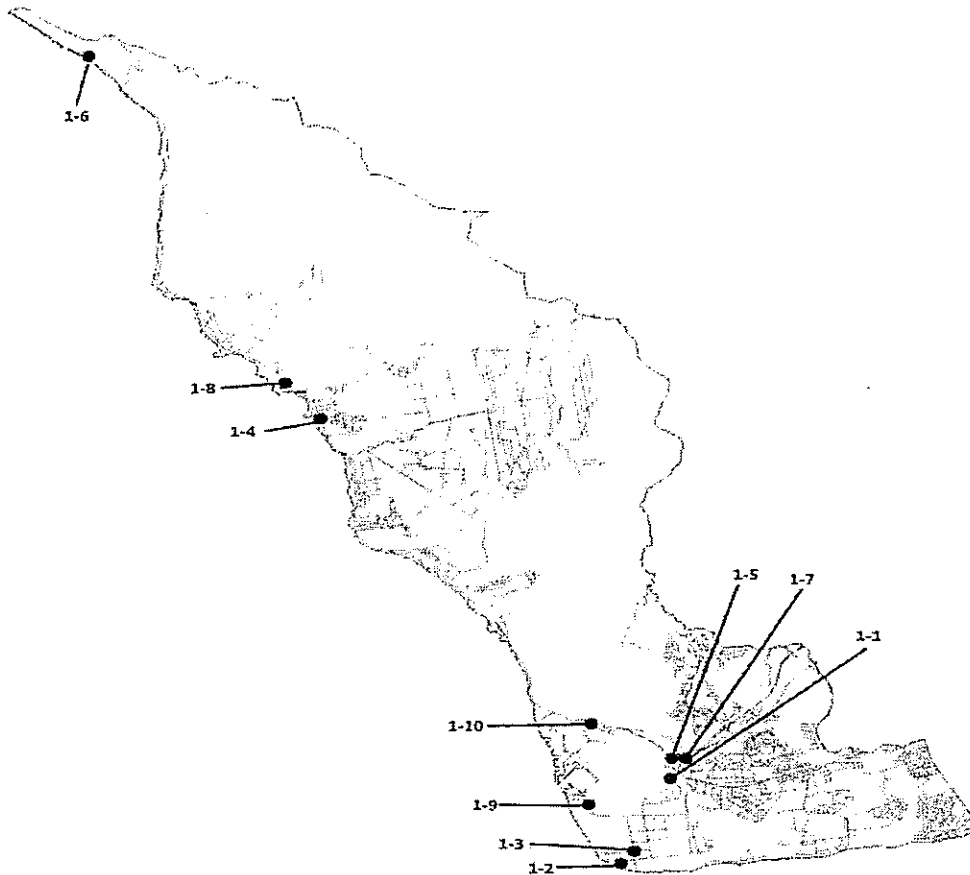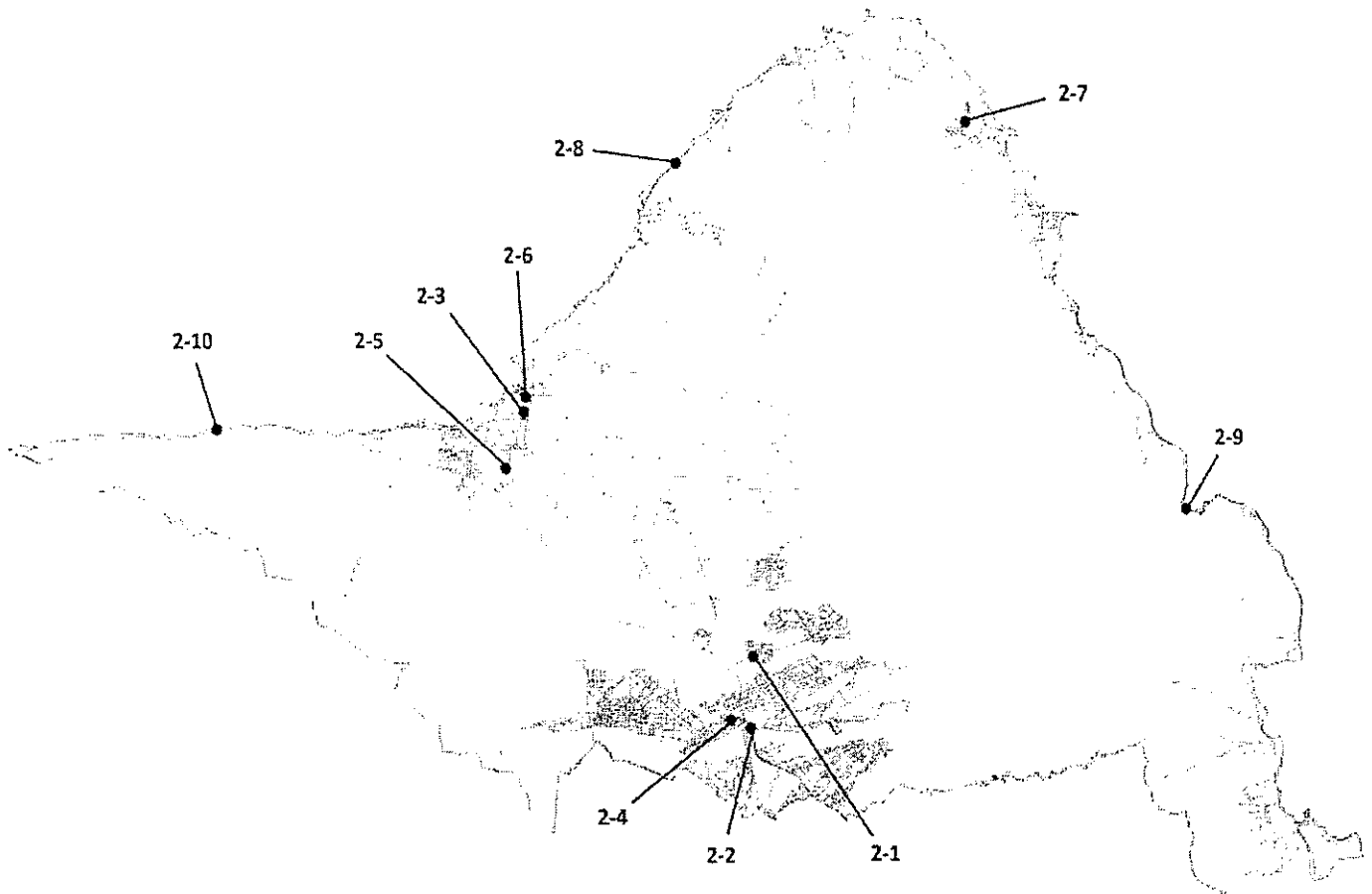|	District 2 Sites			
#	Area/Street	Starting Point	End Point	Score
1	Kulia St.	503 Kulia St. at Whitmore Ave.	Hanau St.	1.3
2	Exit 8 South Ramp	Exit 8 Sign above Higgins Rd.	Kamehameha Hwy.	2.3
3	Kamehameha Hwy.	Haleiwa Art Gallery	Emerson Rd.	1.3
4	I-H-2 (Wilikina Dr.)	Exit 9 sign	Exit 8 sign	1.7
5	Hwy. 930 (Kaukonahua Rd.)	66-935 Kaukonahua Road	Kaukonahua Rd. veers right	2.0
6	Kamehameha Hwy.	Teddy's Burgers	Achiu Ln.	1.7
7	Kamehameha Hwy.	Kahuku Community Center	56-449 Kamehameha Hwy.	1.3
8	Ehukai Beach Pk./Banzai Walk Path	Driveway: 59-3337 Ke Nui Rd.	End of path	1.0
9	Kamehameha Hwy. (Hwy. 83)	Ahupuaa O Kahana St. Park	Kaluapuleho Point	1.7
10	Farrington Hwy. (Hwy. 930)	Dillingham Field Glider Port	YMCA Camp	3.7

Figure 7 - District 2 Sites Map

District 3

Table 8 - District 3 Site Locations and Scores

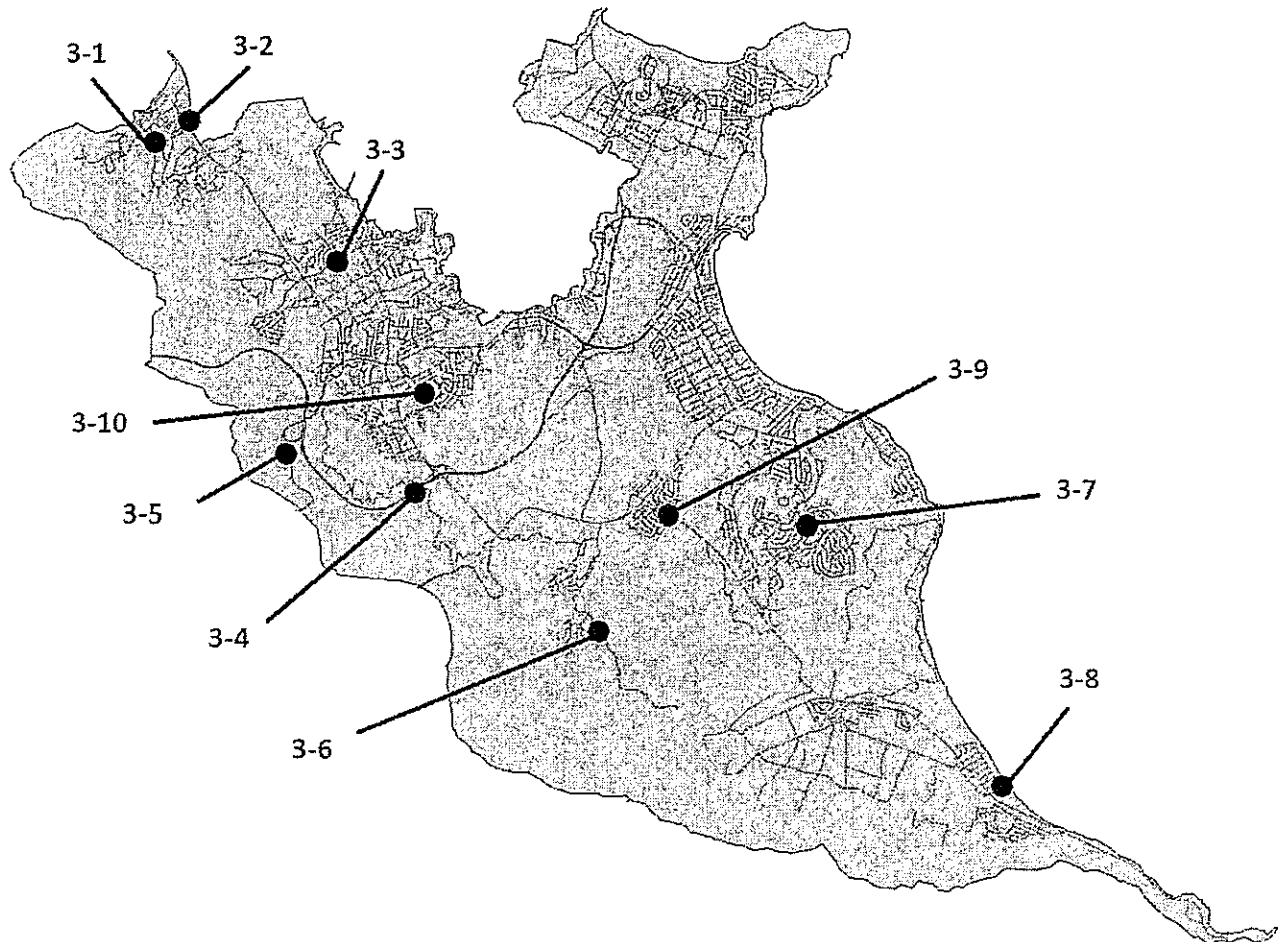| #	Area/Street	Starting Point	End Point	Score
1	Hui Lo St.	47-519 Hui Lo St. at Alwawiki St.	Cul-de-sac	1.0
2	Kahekili Hwy.	47305 Kahekili Hwy. at Ahuimanu Place	Ahaolelo Rd.	1.0
3	Haiku Rd./Lilipuna Rd.	46-103 Alaloa St.	Nahiku St.	1.0
4	I-H-3 (John Burns Fwy.)	Sign for Exit 11 (Kamehameha Hwy.)	Rural area - no landmark	2.0
5	Hwy. 63 (Likelike Hwy.)	Sign for Likelike Hwy. at Kaheliki Hwy.	Exit for Kaheliki Hwy.	1.7
6	Maunawili Falls Trailhead	Maunawili Rd. at 1202 Kelewina St.	350 yards inside trail	1.3
7	Keolu Dr.	1080 Keolu Dr. near Hui St.	Iana St.	1.0
8	Wailea St.	41-10 Wailea St. at Laumilo St.	Hilu St.	2.0
9	Kalanianaole Hwy.	Corner of Ulupii St. at 1410 Ulupii St.	Keolu Dr.	1.3
10	KOA Kahiko St.	45-402 Akimala St. at Kahiko St.	Kamehameha Hwy.	1.0

Figure 8 - District 3 Sites Map

District 4

Table 9 - District 4 Site Locations and Scores

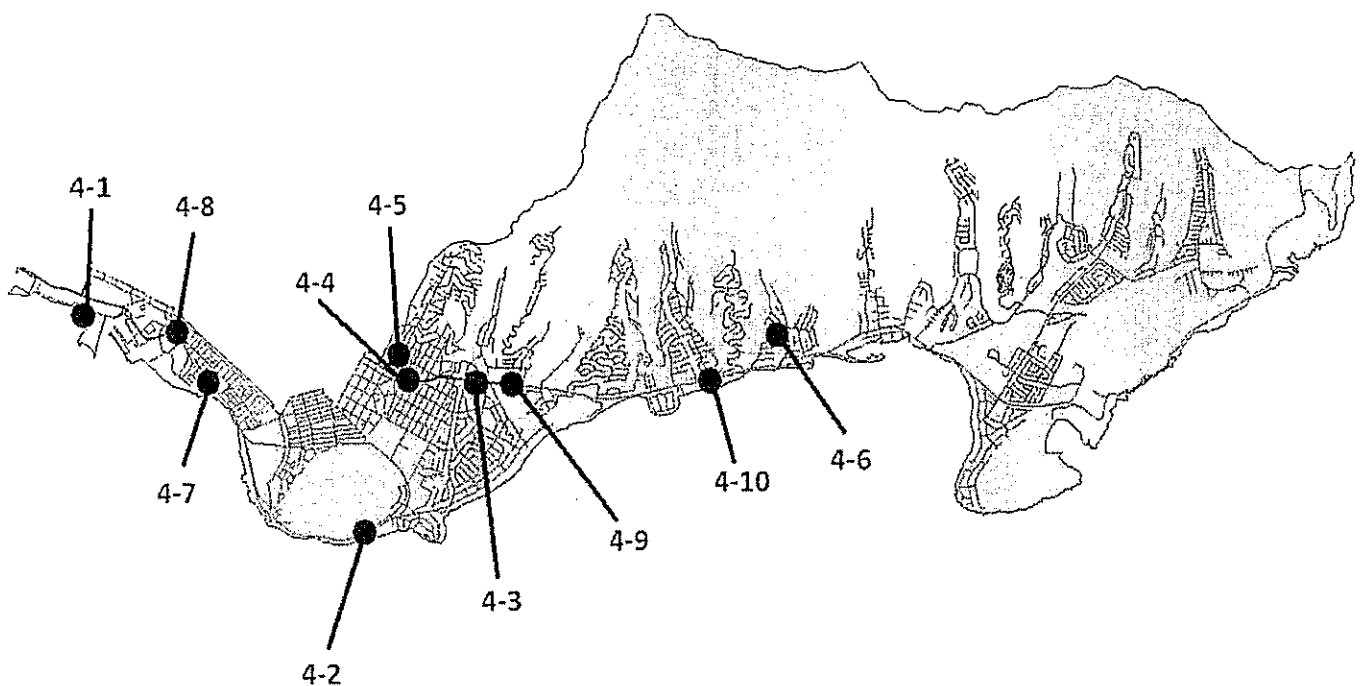| #	Area/Street	Starting Point	End Point	Score
		District 4 Sites		
1	Ala Moana Beach Park	Start of pathway behind beach	End of pathway	2.7
2	Diamond Head Rd.	3603 Diamond Head Rd.	Beach Rd./Diamond Head Rd. merge	1.7
3	Kahala Mall	Chili's (4211 Waialae Ave.)	Macy's	1.3
4	H-1 (Lunalilo Fwy.)	Exit 26B	Exit 27	1.7
5	Waialae Ave.	3619 Waialae Ave. at Koko Head Ave.	4th Ave.	2.0
6	Halemaumau St.	297 Halekamani St.	Kalanianaole Hwy. (Hwy. 72)	1.3
7	Kalakaua Ave.	2284 Kalakaua Ave. at Dukes Ln.	Ohua Ave.	1.7
8	Pau St.	400 Pau St. at Kalakaua Ave.	Ala Wai Blvd.	2.0
9	I-H-1, Exit 27	Bridge directly before Exit 27	Kilauea Ave.	1.3
10	Kalanianaole Hwy.	5339 Kalanianaole Hwy. at E. Hind Dr.	Niuiki Circle	1.7

Figure 9 - District 4 Sites Map

District 5

Table 10 - District 5 Site Locations and Scores

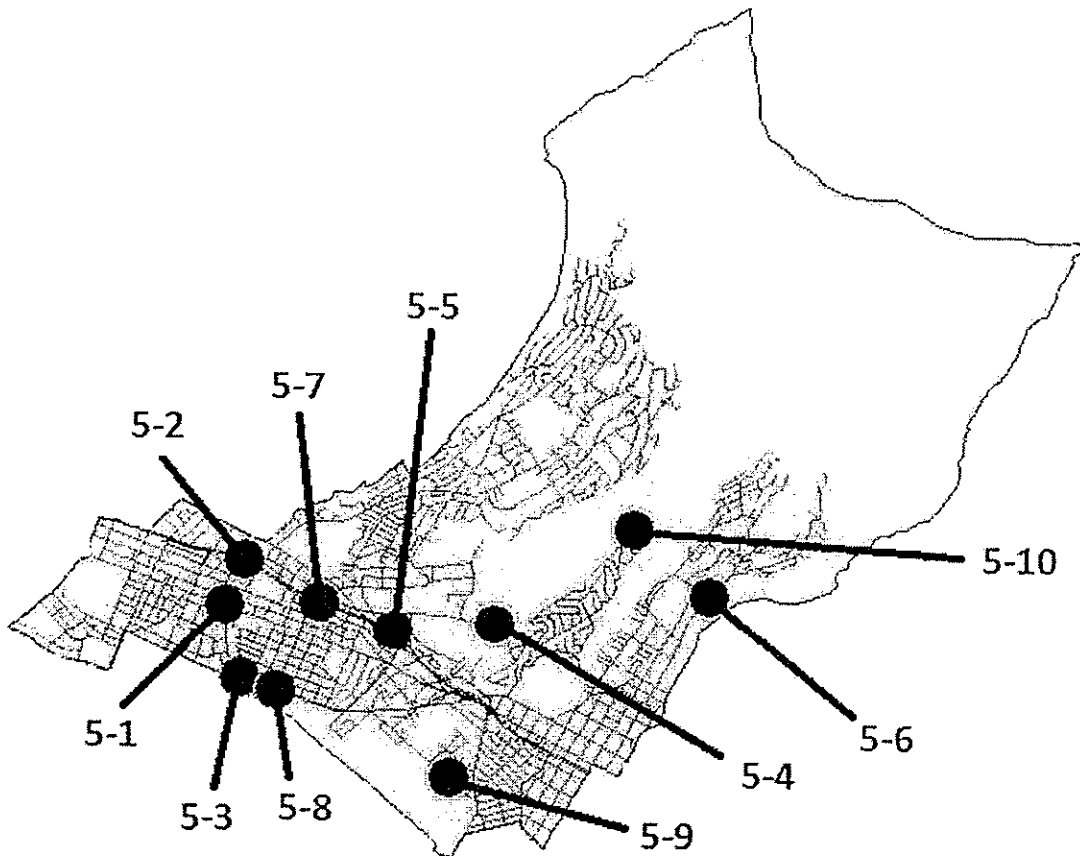| #	Area/Street	Starting Point	End Point	Score
1	South King St.	1540 South King St. at Kalakaua Ave.	Makahiki Way	2.3
2	Lunalilo Fwy.	Sign for Exit 23	Artesian St.	2.0
3	Kapiolani Blvd.	1750 Kalakaua Ave.	Kona Iki St.	1.5
4	Dole St.	2802 Dole St. (Waahila Faculty Apts.)	Hoonanea St.	1.8
5	Wilder Ave.	2458 Wilder Ave.	Oliver St.	1.8
6	10th Ave.	2066 10th Ave. at Kiwila St.	Pakui St.	1.8
7	I-H-1 X24A to frontage	Exit at 2031 Bingham St.	Coyne St.	1.8
8	Ala Wai Comm. Park	2003 Kapiolani Blvd. at McCully St.	Hoawa St.	2.0
9	Date St.	2854 Date St. at Ekela Ave.	Kapiolani Blvd.	2.3
10	Ruth Place	Waahila Ridge State Park Entrance	Saul Place	1.0

Figure 10 - District 5 Sites Map

District 6

Table 11 - District 6 Site Locations and Scores

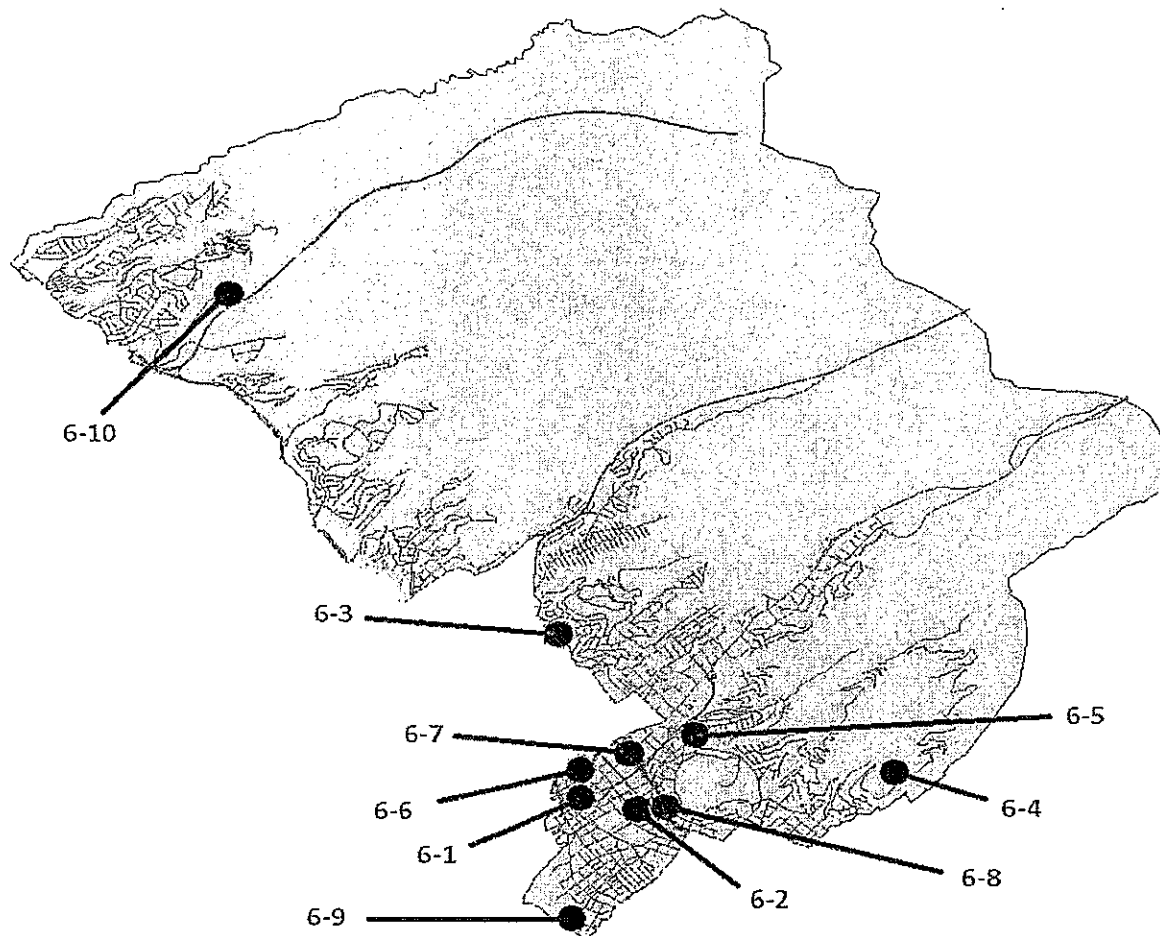| #	Area/Street	Starting Point	End Point	Score
	District 6 Sites			
1	Bishop St.	1164 Bishop St. to Aloha Tower Dr.	177-199 Aloha Tower Dr.	1.0
2	Punchbowl St.	1381 Punchbowl St. at Miller St.	Ala Moana Blvd.	1.5
3	Hala Dr.	1338 Hala Dr. at Houghtailing St.	Kalepa St.	1.5
4	Nutridge St.	Tantalus Lookout	Round Top Dr.	1.0
5	Pauoa Rd.	2124 Pauoa Rd.	Kapulei St.	1.0
6	River St.	198 N. Beretania St. at River St.	North Nimitz Hwy.	1.5
7	Foster Botanical Gardens	Nuuana Ave. at School St.	After N. Vineyard Blvd. canal	1.3
8	Dole Park entrance, lot, bus stop	602 Magellan Ave. & Frear St.	Basketball court on Alapai St.	3.3
9	Kakaako Waterfront Park	Left end of parking lot	Right end of parking lot	3.0
10	Iwaena St.	Cul-de-sac: 99-1269 Iwaena St.	Iwaiwa St.	2.0

Figure 11 - District 6 Sites Map

District 7

Table 12 - District 7 Site Locations and Scores

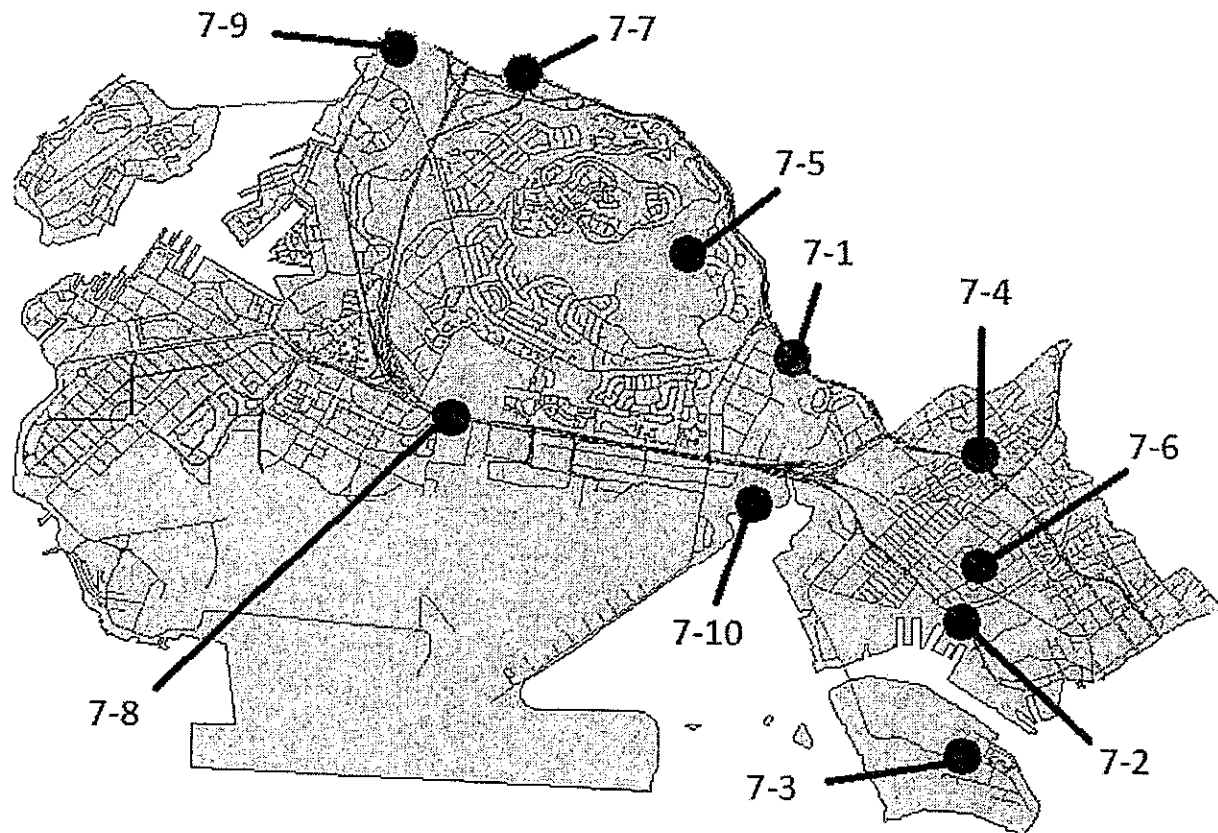| #	Area/Street	Starting Point	End Point	Score
	District 7 Sites			
1	North King St. (I-H-201)	Above creek before Affordable Casket	Ola Ln.	3.0
2	N. Nimitz Hwy. (Rt. 92)	1133 N. Nimitz Hwy.	420 N. Nimitz Hwy.	2.0
3	Sand Island Pkwy. 64	1198 Makepono St.	1601 Sand Island Pkwy.	1.8
4	Pahukui St.	1247 Gulick Ave.	1323 Gulick Ave.	2.5
5	Ala Puumalu Park	1570 Ala Puumalu St.	Honolulu Country Club	1.0
6	Kaumualii St.	707 Waiakamilo Rd.	Kohou St.	4.0
7	Moanalua Fwy.	Kahuapaani Overpass	Sign for Exit 1-D	1.8
8	Elliott St. (under overpass)	I-H-1 Exit at 351 Elliott St.	Kuntz Ave. & Elliott St. split	1.5
9	Moanalua Fwy.	Hwy. 99 splits to Hwy. 78/I-H-201	Exit 1-A (I-H-1 E to Pearl Harbor)	1.5
10	Keehi Beach Park	465 Lagoon Dr.	Parking lot & comfort center	2.0

Figure 12 - District 7 Sites Map

District 8

Table 13 - District 8 Site Locations and Scores

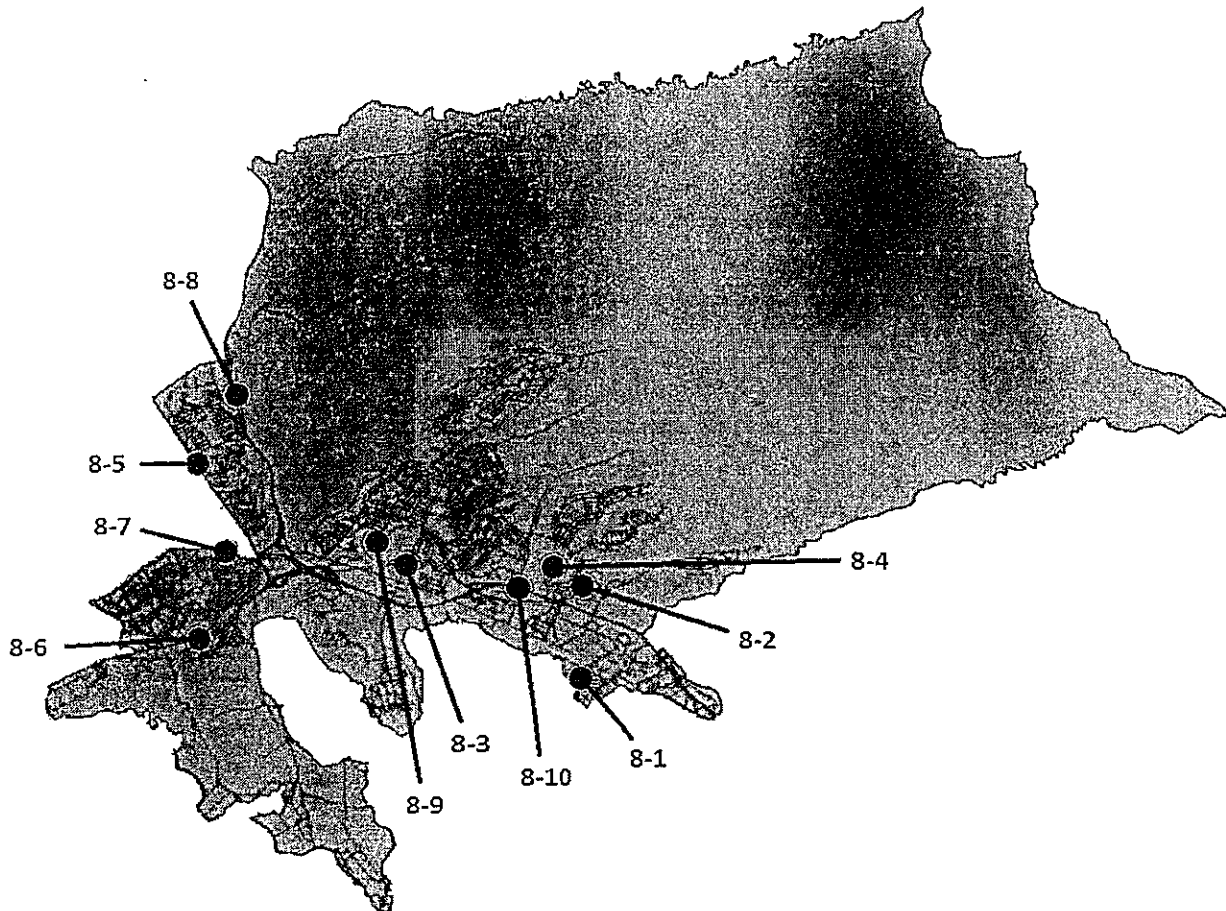| #	Area/Street	Starting Point	End Point	Score
	District 8 Sites			
1	Pearl Harbor Bike Path	98-183 Aiea Kai Way	Kamehameha Hwy./McGrew Loo	2.0
2	Pono St.	98-421 Pono St. at Ponohana Loop	Moanalu Rd.	1.3
3	Luehu St.	Corner of 1138 Waimano Home Rd	End of road at Post Office	1.3
4	Newtown Park (Lulu St.)	Park Entrance (98-456 Kaahele St.)	Tennis Courts	1.0
5	Waipio Shopping Center Lot	Taco Bell/Pizza Hut lot	Big City Diner lot	1.3
6	Farrington Hwy.	94-910 Moloalo St.	Waikele Rd.	2.0
7	Queen Liliuokalani Hwy.	Sign: Exit 7 in 1/2 Mile	Exit 7	2.0
8	Vet. Mem. Fwy. off-ramp	Exit 2 (Ka Uka Blvd.)	Off-ramp merges	2.3
9	Kuala St.	1110 Kuala St. at Makolu St.	Kamehameha Hwy.	1.7
10	I-H-1	Exit 10 Sign	HECO Electric Power	2.0

Figure 13 - District 8 Sites Map
District 9

Table 14 - District 9 Site Locations and Scores

| #	Area/Street	Starting Point	End Point	Score
		District 9 Sites		
1	Lumiaina St.	94-799 Lumiaina St.	Inspire Church at Pulelo St.	1.0
2	Kunia Rd. (Hwy. 750)	Plantation Rd.	Rural area - no specific landmark	2.0
3	Kaweloalii St.	94-471 Kaweloalii St.	Hokuahiahi St.	1.0
4	Iroquois Dr.	5093 Iroquois Dr.	N Rd./12th St.	2.0
5	Ewa Beach Park	Ewa Beach Library	Loop back to library	2.0
6	Farrington Hwy.	94-30 Farrington Hwy.	Leokane St.	2.0
7	I-H-1	Exit 7 off-ramp to Waikele	Merge with Paiwa St.	2.0
8	Kunia Rd. and Kapuna Loop	Denny's at Kapuna Loop	Kapuna loops into Kunia Rd.	1.3
9	Kunia Rd.	I-H-1 Exit 5B Ramp to Kunia	Anonui St.	1.7
10	W. Loch Dr.	Intersection with Iroquois Rd.	Private Gov't pull-off on right	2.0
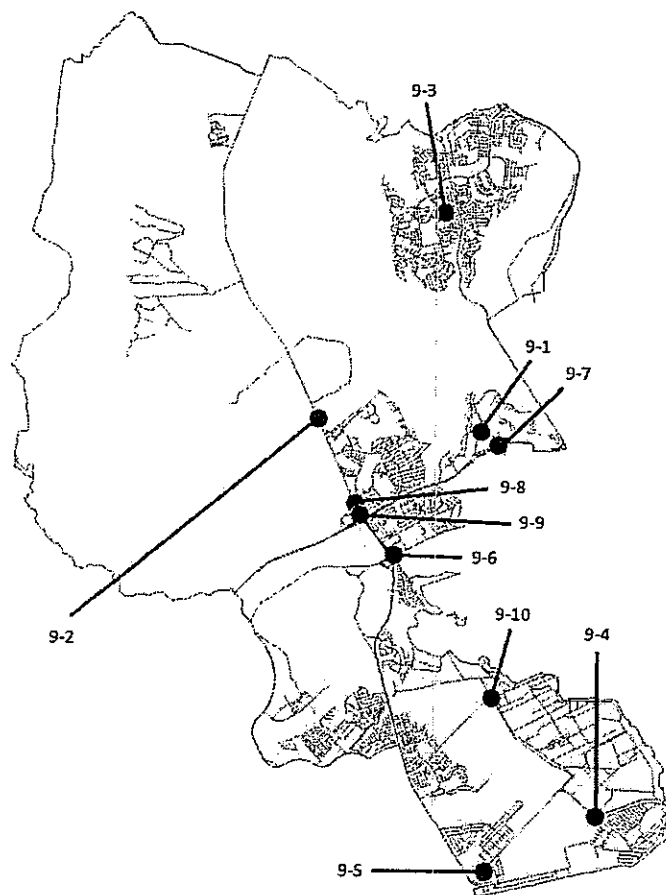
Figure 14 - District 9 Sites Map

In addition to calculating average Litter Index scores, statistical procedures and tests were performed on the data. Among these were tests to determine if any significant differences existed between litter rates on the different land use types, roadway types, or districts.

Land Use Types

Analysis showed that industrial sites had the greatest variability of scores, from a minimum of 1, the lowest (best) possible score to a maximum of 4, the highest possible score. Industrial site scores also had the greatest standard deviation, a measure of variability. Commercial and recreational scores range from the minimum of 1 to maximums of 3.00 and 3.67, respectively; their standard deviations also reflect considerable variability of scores for these areas, especially for recreational sites. Residential and rural sites had more uniform scores, each area with a range (maximum minus minimum) of exactly one score point and lower standard deviations than the other areas.

No single score in residential sites exceeded 2.0, indicating the overall cleanliness of these sites. A statistical t-test was performed to examine the extent of the difference between residential scores and the aggregation of scores for all other land use types. The test result showed that the difference was statistically significant (at the .05 level); that is, the average Litter Index score for residential sites (1.5) was significantly lower than the average for the other areas combined (1.9), reinforces the notion that residential sites are less littered.

Conversely, industrial sites had the highest average Litter Index score (2.3), and a statistical test showed this figure to be significantly higher (at the .05 level) than the average for the aggregate of other areas. Thus, it is reasonable to conclude that industrial sites are the most heavily littered.

These results, not surprisingly, do confirm that residential areas are generally less littered than other land use areas, while litter rates in industrial areas are less predictable but higher on average.

Roadway Types

Arterial roads, least traveled of the various roadway types, also had the least variability in their scores, ranging from the minimum of 1.0 to a maximum of 2.67, with the lowest standard deviation of litter scores. Furthermore, as shown in Table 3 (page 7), they had the lowest Litter Index score (1.6). Thus, arterial roads were the most predictable in terms of generally low rates of litter.

A statistical test confirmed that the average litter score for arterial roads was significantly lower (.05 level) than the average score for other roadway types combined. Other roadway types proved more difficult to predict in terms of litter rates, with greater ranges of scores and greater variability among their scores.

Analysis of Sites by District

Another way of analyzing relative litter in the different districts is to note how many sites in each district had above average littering rates.

District 1, with the highest litter rate, also had the largest number of sites (eight) that were higher than the average score. Similarly, District 3, which yielded the lowest litter rate, had the least number of sites (two) exceeding the overall average score.

Of interest are District 9 and District 6, which were tied as the second cleanest districts. However, District 9 had six sites that exceeded the overall average score, while District 6 had just three sites exceeding the overall average. This suggests that District 9 had both clean and littered sites, while the sites in District 6 were more similar in their littering rates.

Understanding which areas and roadways are likely to have predictable littering rates will help officials craft programs specifically designed to address littering in those areas. Analyzing similar dynamics within each District can help officials design more effective programs for each area.

The most helpful follow-up efforts would be those that focus on industrial areas, expressways and ramps since traffic density in these areas tends to be higher. Individually, districts will find it useful to address sites within their areas that had the highest Litter Index scores.

The recommendations below reflect observations based on the Litter Index conducted throughout Oahu in January 2017.

1. Oahu is generally a clean island overall, yielding a 1.8 score (slightly littered,) with only eight of the 90 sites having a score of 3.0 or greater. The areas around these eight sites would be a good target for initial litter abatement efforts.

2. In terms of roadway types, it will be helpful to focus littering behavior initiatives on expressways and ramps. In addition to higher traffic volumes, these types of roadways have a preponderance of tractor trailer and solid waste collection vehicles which are more prone to unintentional littering than other vehicles.

3. In terms of land use types, it will be helpful to focus littering behavior initiatives on industrial areas, which experience higher levels of traffic and movement of materials. Partnering with businesses, especially in industrial areas, can help maintain cleaner roadways.

4. Conducting the annual Litter Index by affiliates is required by Keep America Beautiful to maintain good standing as an affiliate. The Litter Index will help community stakeholders identify trends and areas of concern.

5. Open-topped trash receptacles without lids were observed to be a source of litter in recreational and residential areas throughout Oahu. Ensuring that trash containers are lidded will help prevent unintentional windblown litter.

6. Bulk and construction waste that are set out well before collection days can unintentionally cause and encourage littering in such areas. The local community's awareness of the collection schedule along with support from city code enforcement officials can help reduce such litter.

7. Encourage litter abatement partnerships between the local business community and its chain of suppliers.

8. Expand and develop working relationships between volunteer illegal dumping spotters and city enforcement officials.

9. Align city bulk waste collections to account for end-of-month move-outs from residential dwellings.

10. Increase engagement with community organizations and Neighborhood Boards to provide for long-term success and community follow through on the sites monitored.

Figure 6 below shows the location of the sites surveyed in each district. Individual maps with detailed site information were also produced for each district.
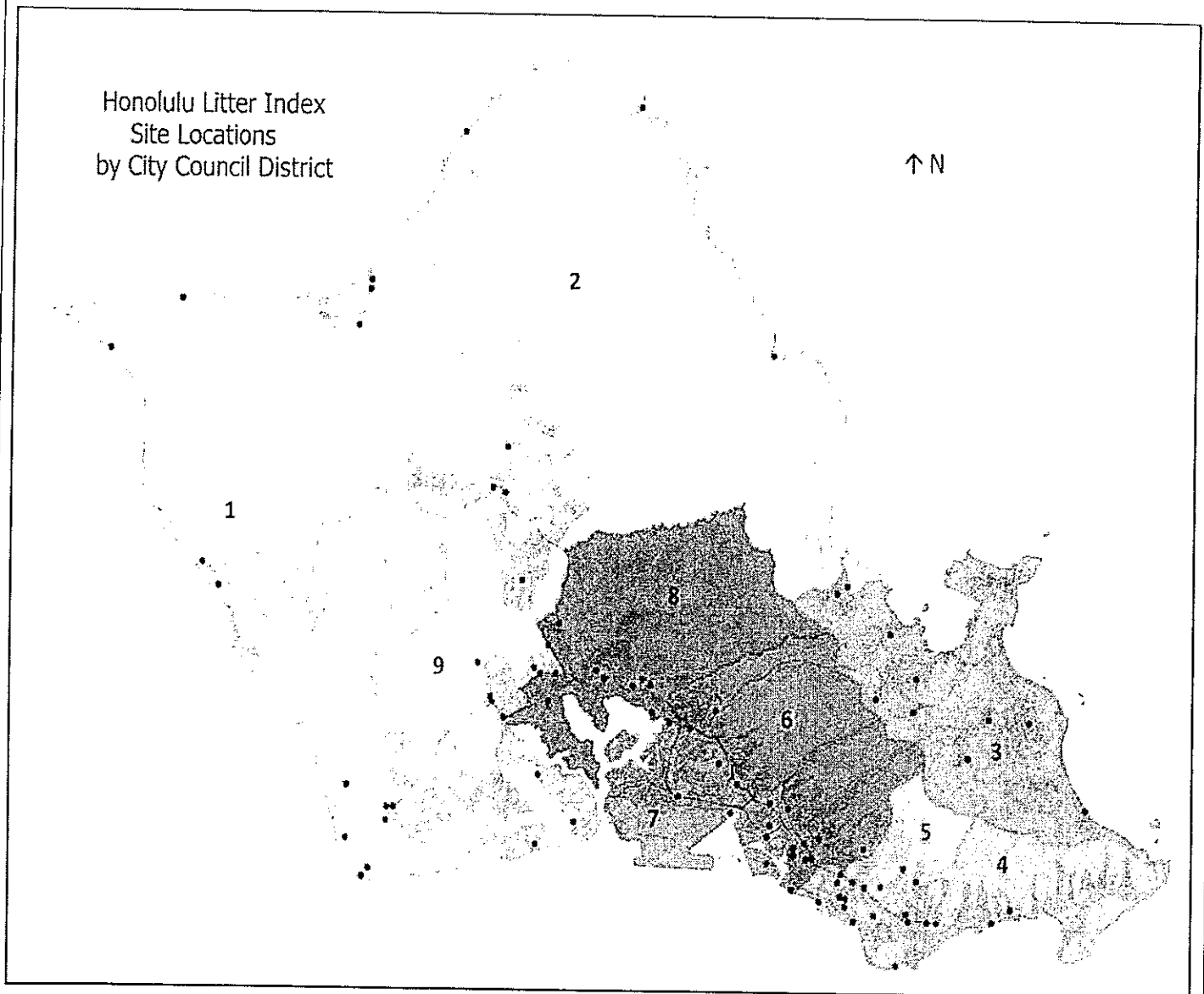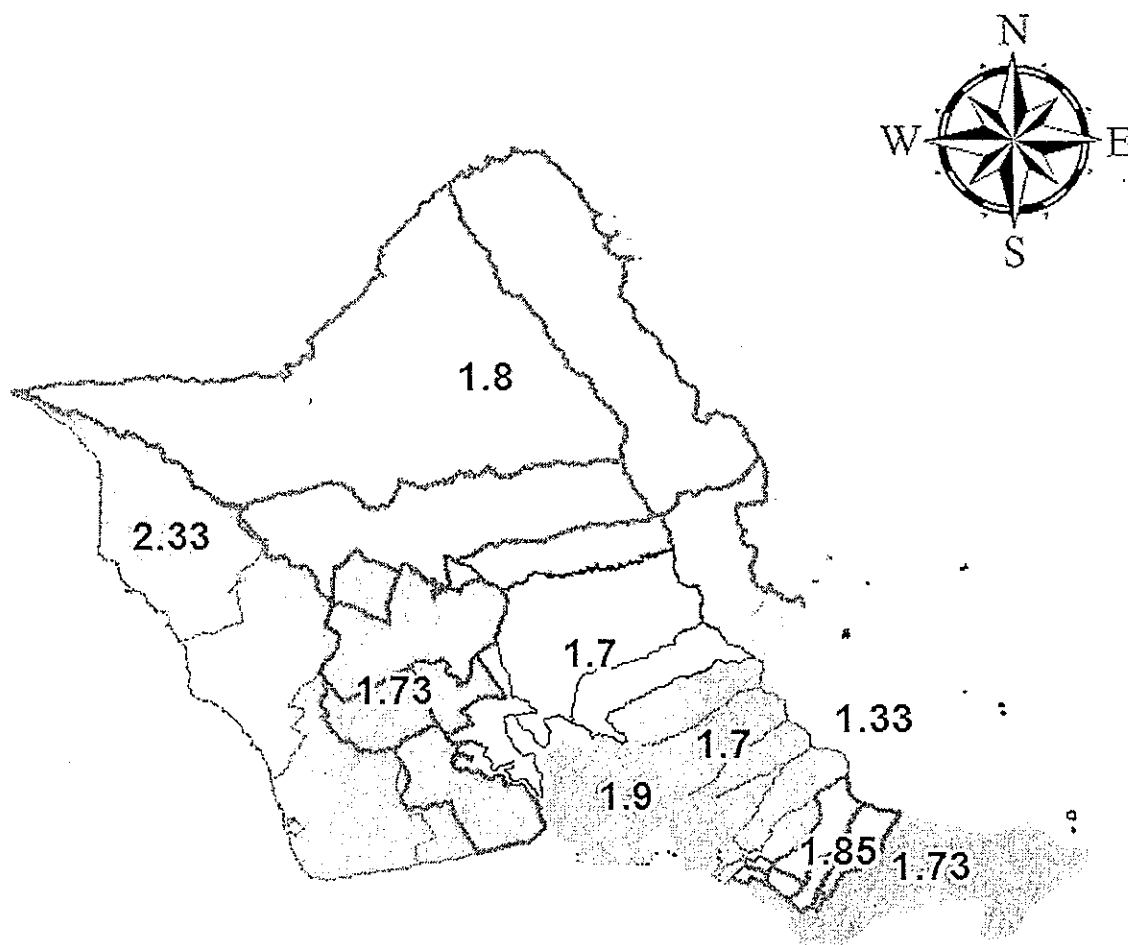
Honolulu Litter Index
Site Locations
by City Council District

↑ N

Figure 15 - Map of Litter Index Sites by District

O'ahu Litter Index
Average District Scores

N
W E
S

1.8

2.33

1.73

1.7

1.33

1.7

1.9

1.85 1.73

O'ahu is divided into nine City Council
districts and subdivided into neighborhood
boards outlined in grey.
Floating scores represent averages
for each City Council District.

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston

Figure 16 - Average District Scores

O'ahu Litter Index
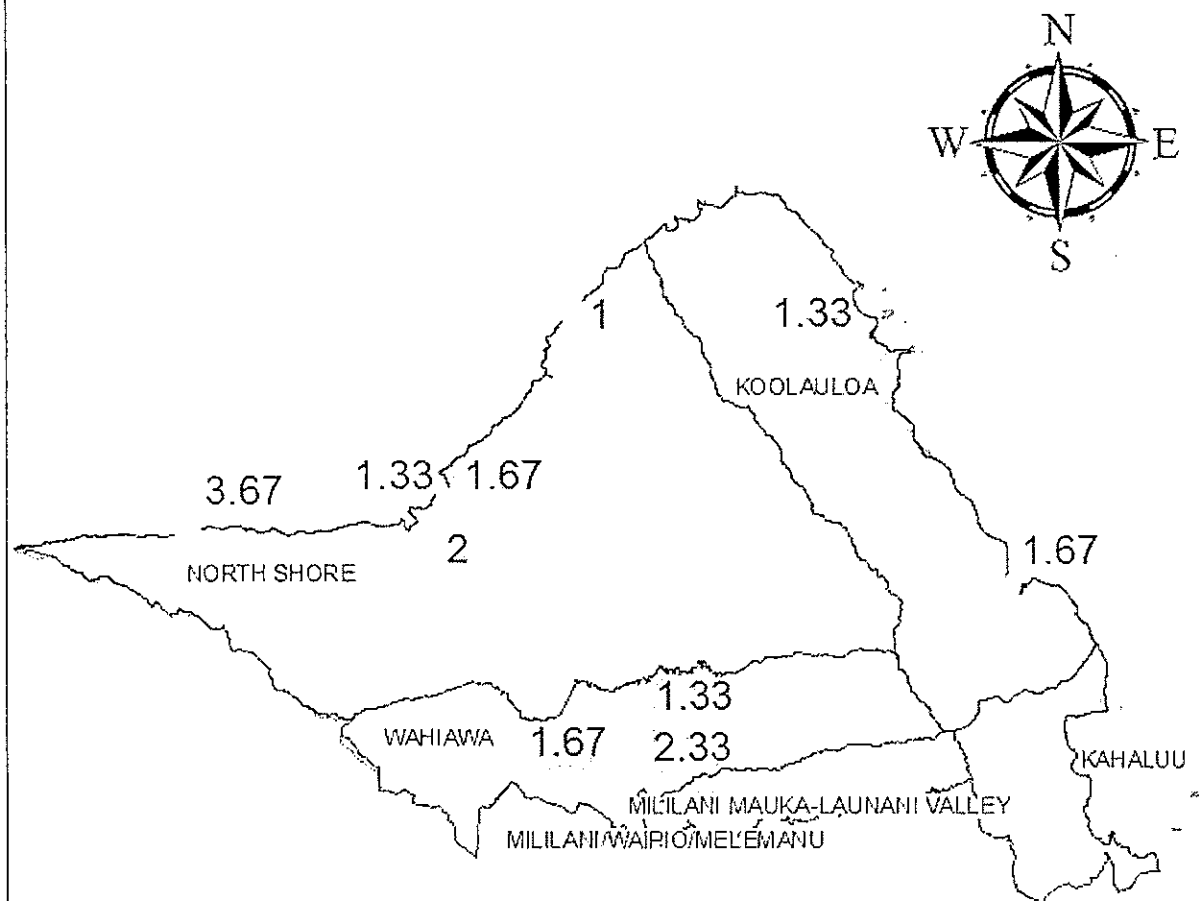Average Scores in City Council District One

1.33

WAIANAE

2.67
2.67

NANAKULI/MAILI

2

EWA

3

MAKAKILO/KAPOLEI/HONOKAI HALE

2.67
1

3

2.67

EWA

Legend

—— Oahu Major Roads

Oahu Streets

Neighborhood Boards

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston

Figure 17 - Average Scores for District One Sites

O'ahu Litter Index
Average Scores in City Council District Two

1

1.33

KOOLAULOA

3.67   1.33 1.67

2

NORTH SHORE

1.67

1.33

WAHIAWA   1.67   2.33

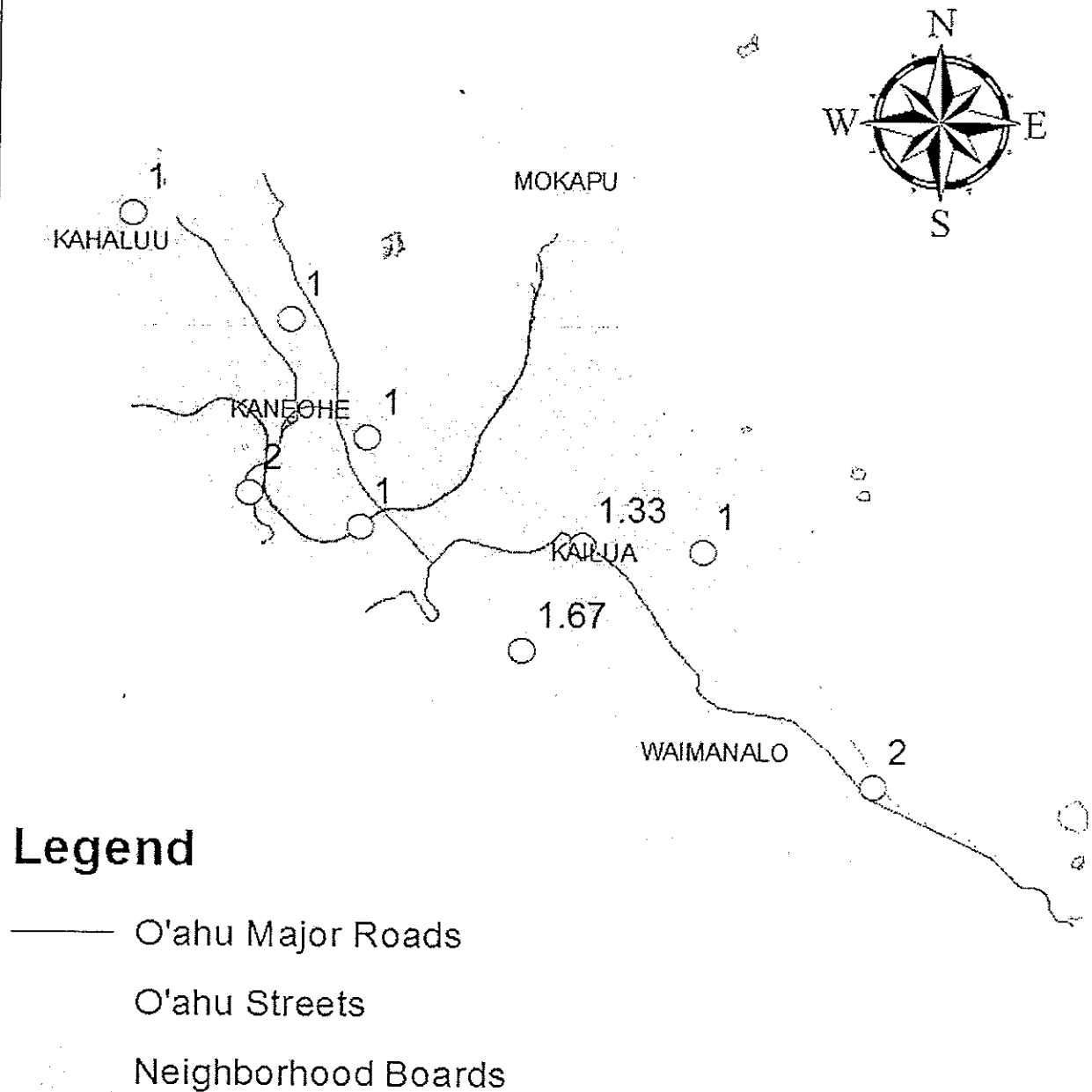MILILANI MAUKA-LAUNANI VALLEY

KAHALUU

MILILANI/WAIPIO/MELEMANU

Legend

O'ahu Streets

O'ahu Major Roads

Neighborhood Boards

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston
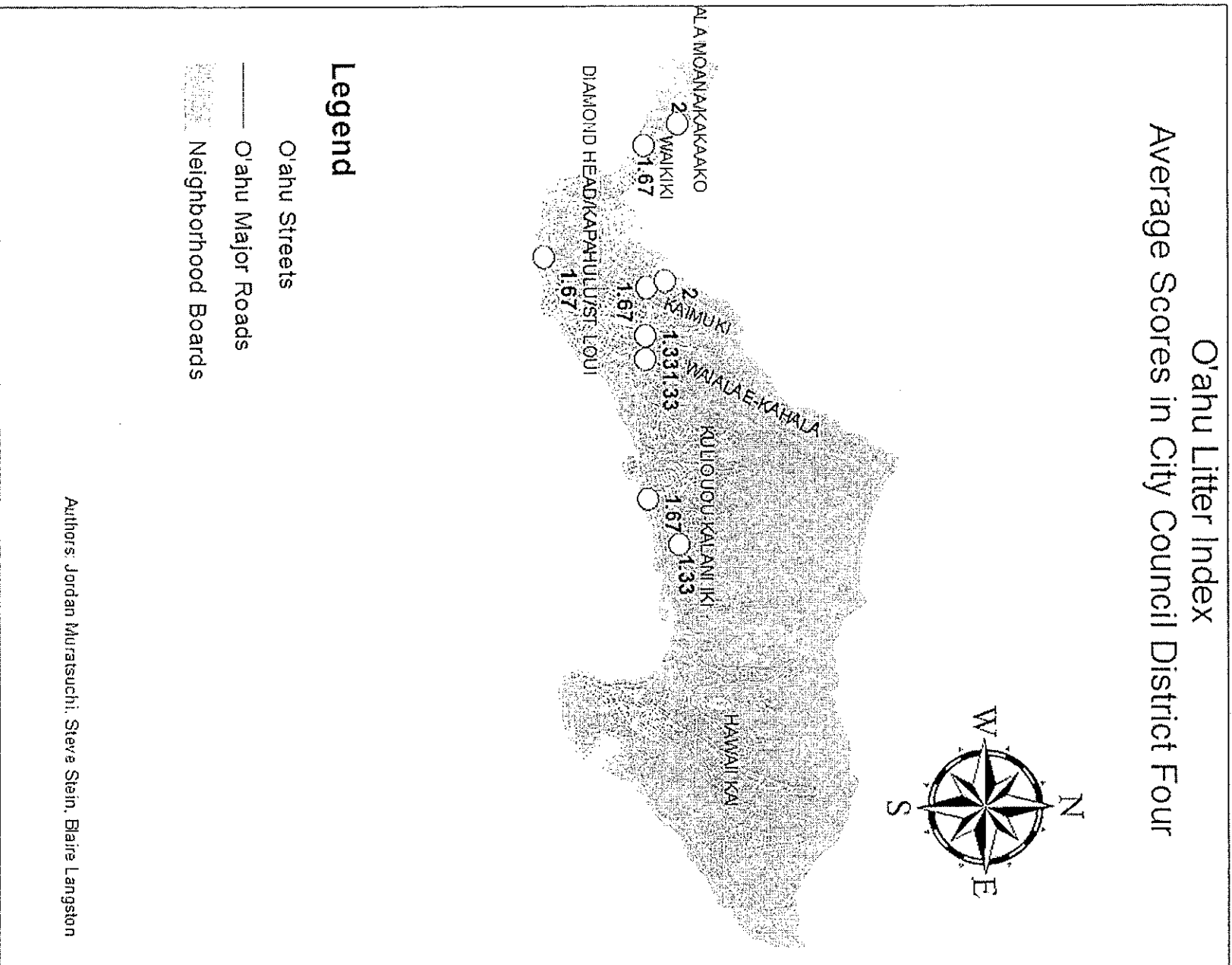
Figure 18 - Average Scores for District Two Sites

O'ahu Litter Index
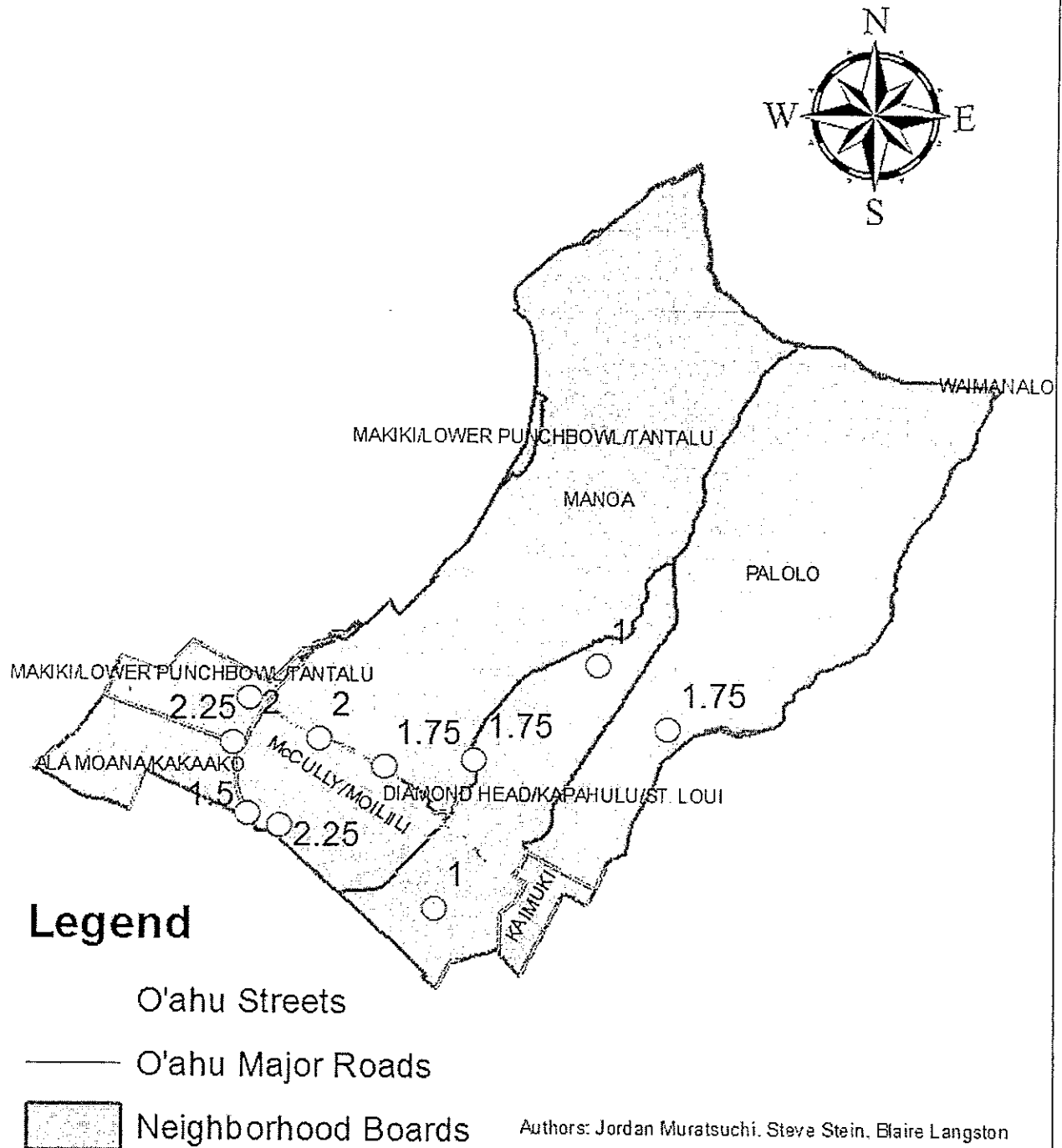## Average Scores in City Council District Three

1

KAHALUU

MOKAPU

N

W E

S

1

KANEOHE 1

2

1

1.33 1

KAILUA

1.67

WAIMANALO 2

Legend

O'ahu Major Roads

O'ahu Streets

Neighborhood Boards

Authors: Jordan Muratsuchi. Steve Stein. Blaire Langston

Figure 19 - Average Scores for District Three Sites

Figure 20 - Average Scores for District Four Sites

Legend

O'ahu Streets

O'ahu Major Roads

Neighborhood Boards

ALA MOANA/KAKAAKO
2
WAIKIKI
1.67

DIAMOND HEAD/KAPAHULU/ST. LOUI
1.67
1.67
2
KAIMUKI
1.33 1.33
WAIALAE-KAHALA

KULIOUOU-KALANI IKI
1.67 1.33

HAWAII KAI

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston

O'ahu Litter Index
Average Scores in City Council District Five

Figure 21 - Average Scores for District Five Sites

Figure 22 - Average Scores for District Six Sites

O'ahu Litter Index
Average Scores in City Council District Seven

Figure 23 - Average Scores for District Seven Sites

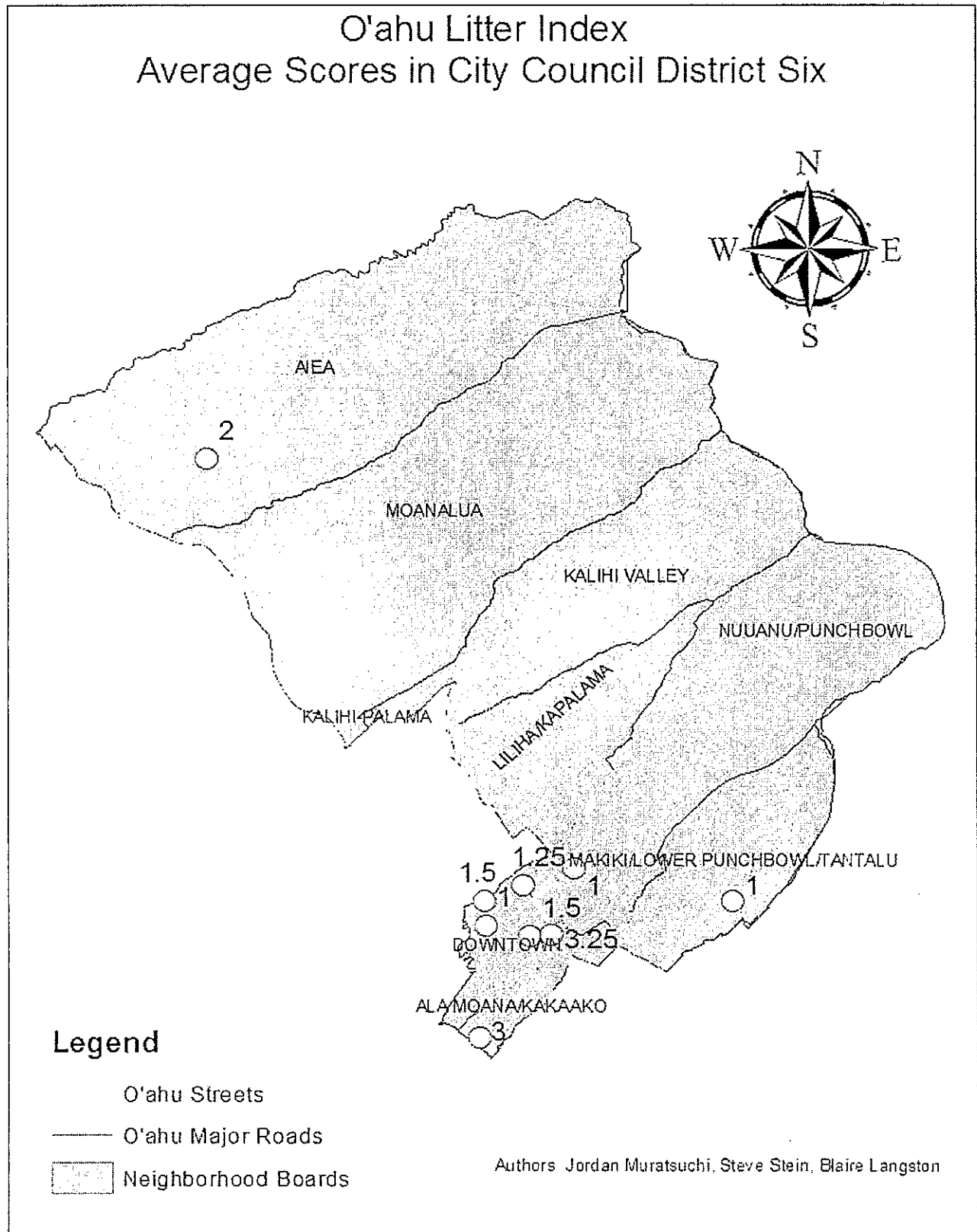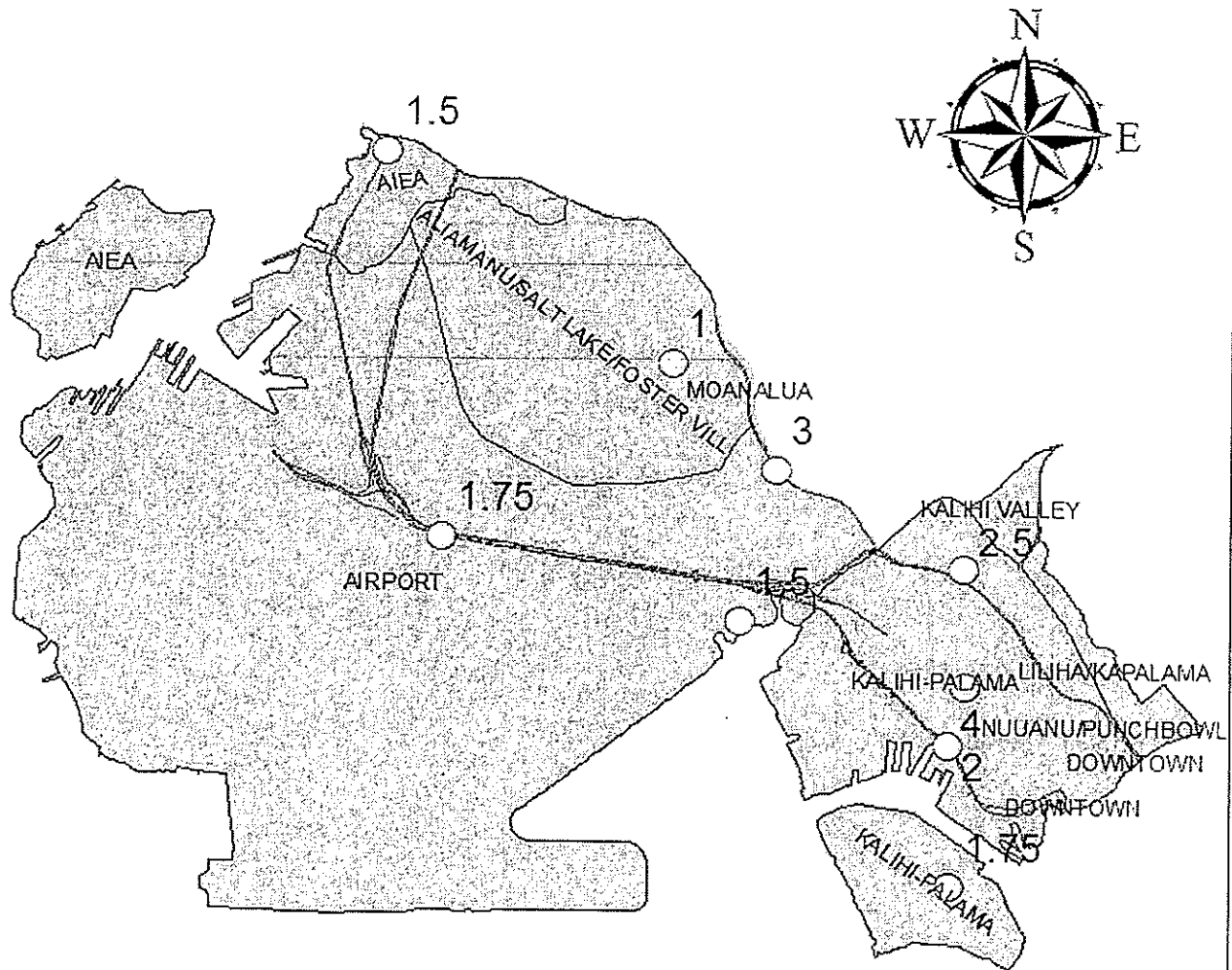**O'ahu Litter Index
Average Scores in City Council District Eight**

N
W ⊕ E
S

PEARL CITY

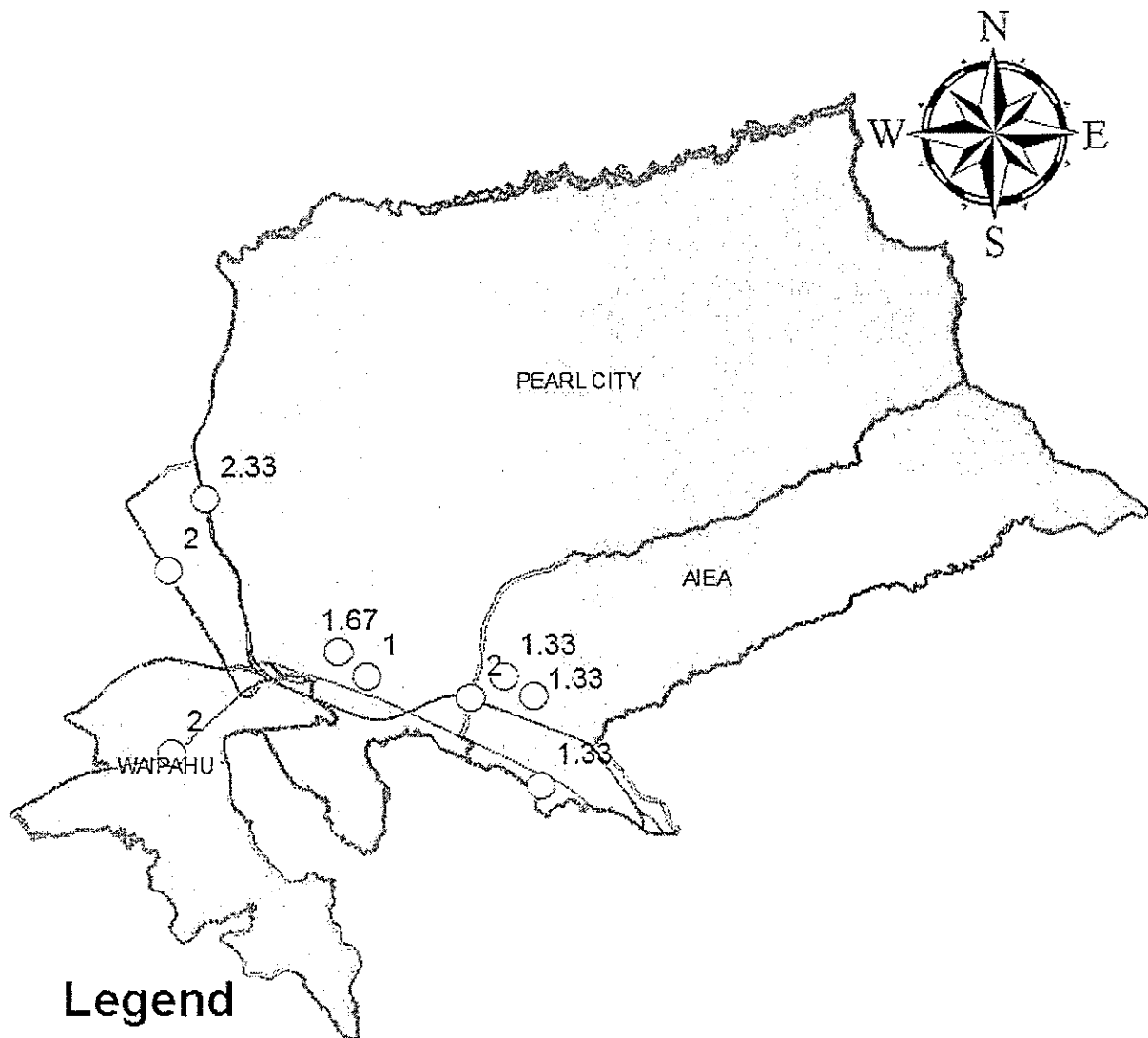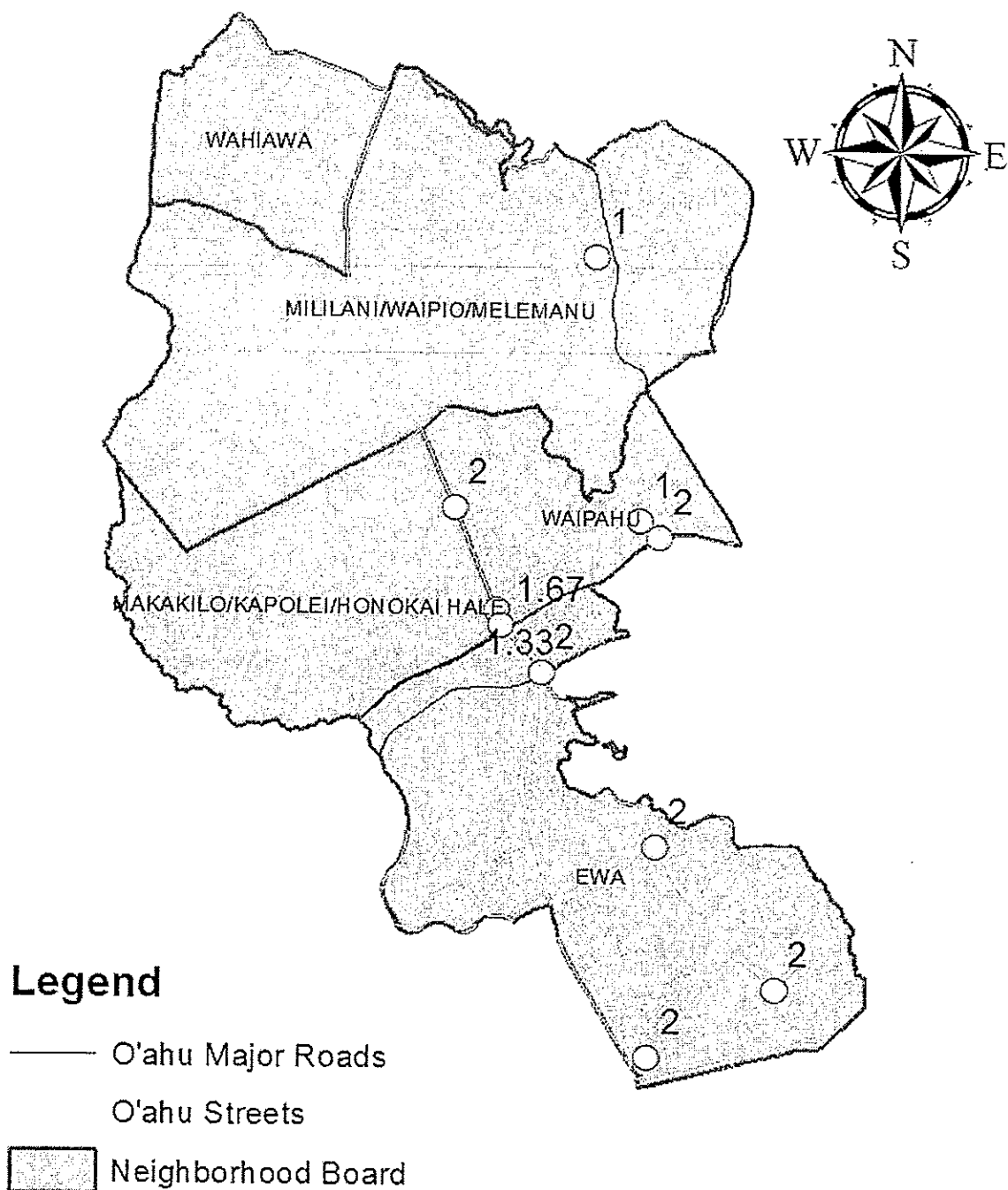2.33

2

1.67
1

AIEA

2
1.33
1.33

2

1.33

WAIPAHU

Legend

—— O'ahu Major Roads

O'ahu Streets

Neighborhood Boards

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston

Figure 24 - Average Scores for District Eight Sites

O'ahu Litter Index
Average Scores in City Council District Nine

WAHIAWA

MILILANI/WAIPIO/MELEMANU

2

WAIPAHU 1 2

MAKAKILO/KAPOLEI/HONOKAI HALE 1.67

1.332

EWA 2

2

2

2

Legend

O'ahu Major Roads

O'ahu Streets

Neighborhood Board

Authors: Jordan Muratsuchi, Steve Stein, Blaire Langston

Figure 25 - Average Scores for District Nine Sites

Site: 1-1

Survey Type: Driving
Survey Target: Kalaeola Blvd.
Starting Point: 2009 Lauwiliwili St. (Hawaii Self-Storage - Kapolei West)
Direction to travel: SW
End Point: Malakohe St.

Site Length: 1.0 miles
GPS Coordinates: 21.3255669, -158.0920793
Road Type: Arterial
Land Use (Area) Type: Industrial
Google Streets link: Site 1-1

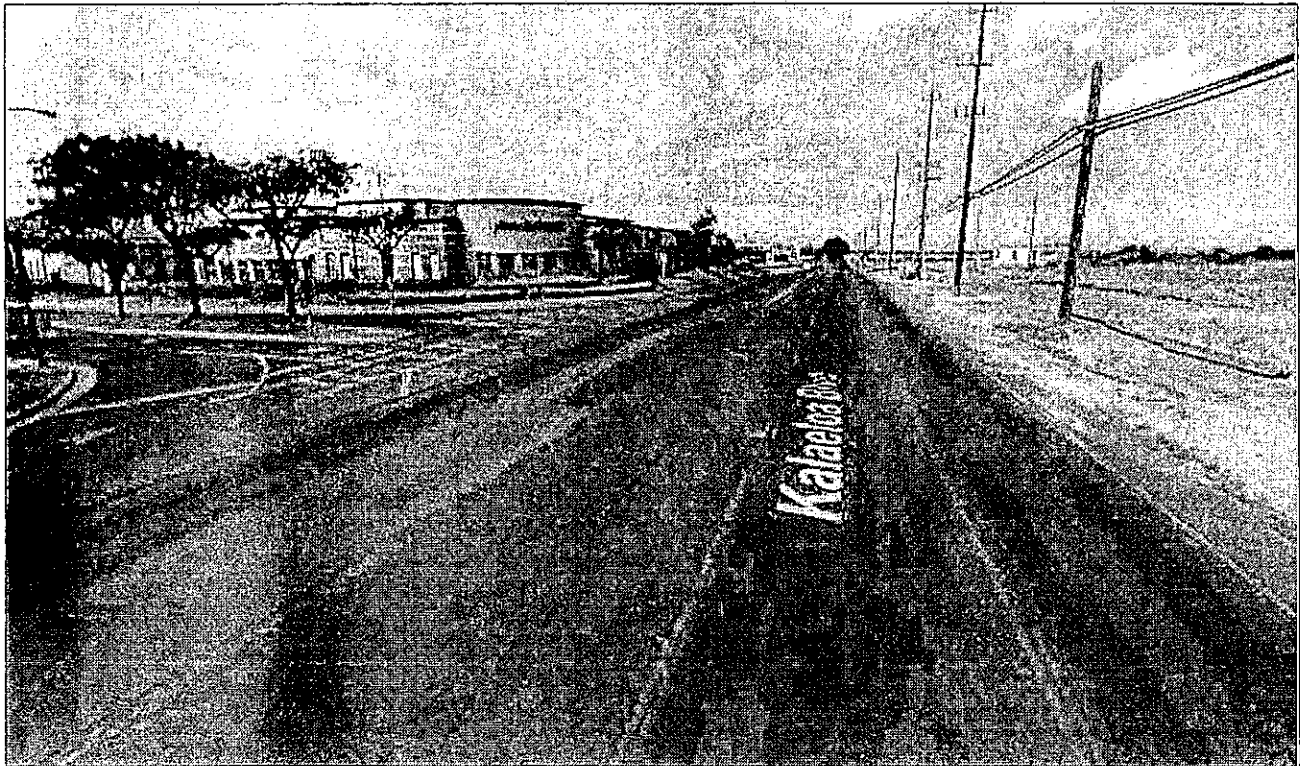**Street map of Site 1-1:** Starting point

Figure 26 - Sample Site Data Sheet

Complete site information and a street map, as shown on this page, was provided for each of the 90 sites along with live links to the online maps.

For further information, see the following:

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